RING ELEMENT DYNAMIC STRESSES

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ABSTRACT

The stresses in the CTRAPRG and CTRIARG ring elements are not calculated for any of the dynamic solutions in the current COSMIC version of NASTRAN. This paper presents a DMAP alter sequence for Solution 8 and post-processing program, NASTPOST, to calculate these stresses. Test cases are presented which describe the method. The stiffness and the consistent versus concentrated mass problems which have been ascribed to this element are reviewed.

The DMAP alter sequence introduces Solution 8 displacements to a Solution 1 module to calculate Real and Imaginary stress components during the execution of Solution 8. The post-processor, NASTPOST, calculates the magnitude/phase stress results.

The DMAP sequence has been written specifically for Level 52 MSC/NASTRAN, but can certainly be used for any COSMIC version with slight modification.

INTRODUCTION

None of the currently documented versions of NASTRAN calculate the dynamic stresses in the CTRAPRG and CTRIARG solid of revolution elements. The stresses for these elements are calculated in NASTRAN for static solutions (e.g., Solution 1) but not in the dynamic solutions (e.g., Solution 8). Comments have been made by others which express the reasons for not including the stress calculations are related to the formulation of the mass matrix for the element.

Sample problems are given to show that the difference between the consistent and concentrated mass approach is greater than one might expect from arguments solely between the merits of consistent or concentrated mass.

This paper describes a DMAP alter sequence for Solution 8 and a post-processing program, NASTPOST, to calculate these dynamic stresses. The DMAP alter sequence introduces the displacements computed in Solution 8 to a Solution 1 module to calculate the complex stresses in the form of real and imaginary components. The post-processor, NASTPOST, calculates the stresses in the form of magnitude/phase.

DISCUSSION

It is not spelled out in the NASTRAN Users Manual that stresses for the solid of revolution elements are not calculated for dynamic solutions. Therefore, if one asks for stresses in a Solution 8 case control, the run is not aborted, but no stresses are obtained.

In order to perform noise path studies of an axisymmetric structure it became necessary to obtain these stresses. At first, the displacements for the entire structure, obtained from a Solution 8 forced vibration analysis were written into an output file; then these displacements, less one, were written into SPC format as enforced displacements for a Solution static analysis (this was done for the real and imaginary components separately). This technique was later modified, utilizing the DMAP alter sequence AOS8$CS and a post-processor, NASTPOST.

The DMAP alter sequence is given in Figure 1. The major points are:

- The user can specify output requests as usual for SPCFORCES and DISPLACEMENTS.
- The user should specify STRESS (PUNCH) = ALL or a particular set ID if he wishes to subsequently use NASTPOST to calculate the magnitude/phase. This punched file will be sent to the users system space. (FOR 013.DAT for the MSC/NASTRAN VAX 11/780 VERSION).
- AOS8$CS should be placed on the user's RFALTER library and executed then by calling RFAI = AOS8$CS.

The program NASTPOST is given in the appendix and is used to calculate magnitude/phase stress components from real/imaginary stress components. The major points are:

- The components from FOR013.DAT above, are used as input to calculate the magnitude/phase stress components.
- This program can be run immediately after the execution of MSC/NASTRAN or at some later time.

The test problem for AOS8$CS and NASTPOST is a circular plate fixed at the edges and driven by a single force, 100 dynes, at the center, normal to the plane of the plate. The finite element control model is the CQUAD2 and CTRIAG2 bending element model shown in Figure 2. The CTRAPRG model, shown in Figure 3, is formulated as a concentrated or consistent mass for each of the runs. The NASTRAN default value is the consistent mass matrix. The concentrated mass matrix is entered as CONM2 data. The three cases are compared in Table 1 for static, 2000 Hz and 8000 Hz at a position near the concentrated load and at the fixed edge.

The concentrated mass formulation gives good results, as compared to the control model. The consistent mass, or default formulation, gives results which do not agree with the control model at either the low, 2 kHz, or high, 8 kHz, forcing frequencies.

The static solution agrees very well with the control model which indicates that the stiffness of the model is represented correctly by solid of revolution elements. The error therefore is associated with the mass matrix formulation. The degree of error is obviously greater than one would expect from the normal arguments of consistent versus concentrated mass differences.[1]

It can be argued that the use of cyclic symmetry with 3D elements rather than solid of revolution elements would have been a possible solution. This is certainly an avenue that deserves added investigation for comparison of cost and accuracy of solution compared to the solid of revolution elements with concentrated mass matrix.

CONCLUDING REMARKS

A DMAP alter sequence for Solution 8 and a post-processing program NASTPOST has been presented to calculate the dynamic stresses in CTRAPRG and CTRIARG solid of revolution ring finite elements. Users of this technique are cautioned to use the concentrated or lumped mass matrix rather than the consistent mass (default value) matrix.

The DMAP sequence has been written specifically for Level 52 MSC/NASTRAN, but can certainly be used for any COSMIC version with slight modification.

REFERENCES

1. Cook, R. D., "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Inc.

TABLE 1

COMPARISON OF STRESSES, 3/8 cm from CONCENTRATED LOAD

FREQUENCY	0[1]	2 kHz	8 kHz
QUAD2	134.4	75.5	66.4
TRAPRG (CONS.)	132.3	17.2	63.1
TRARG (CONC.)	132.3	96.	60.5

TABLE 2

COMPARISON OF STRESSES, 3/8 cm from FIXED EDGE

FREQUENCY	0[1]	2 kHz	8 kHz
QUAD2	44.4	34.2	38.2
TRAPRG (CONS.)	45.6	27.0	10.0
TRAPRG (CONC.)	45.6	33.0	36.0

[1] OBTAINED FROM SOLUTION 1

FIGURE 1 - ALTER AOS8$CS

```
$ BEGINNING OF ALTER AOS8$CS
$
$ THIS ALTER PACKAGE IS USED TO CALCULATE
$
$       *DISPLACEMENTS   (REAL/IMAGINARY) OR
$                        (MAGNITUDE/PHASE)
$
$       *SPCFORCES       (REAL/IMAGINARY) OR
$                        (MAGNITUDE/PHASE)
$
$       *STRESSES        (REAL/IMAGINARY)
$
$   FOR THE CTRAPRG AND CTRIARG RING ELEMENTS
$
$
$ CASE CONTROL INPUT
```

FIGURE 1 - (Cont'd)

```
$
$       THE USER SHOULD SELECT THE DESIRED
$       OUTPUT AS USUAL FOR DISPLACEMENTS
$       AND SPCFORCES.
$
$       THE USER SHOULD SELECT THE PUNCH
$       OPTION FOR STRESS IF IT IS DESIRED TO
$       SUBSEQUENTLY CALCULATE (MAGNITUDE/
$       PHASE) USING A POST-PROCESSING PROGRAM
$
$
ALTER 166
OFP OPPC1,OQPC1,OUPVC1,,,//V,N,CARDNO $
ALTER 185,186
PARAM //STSR/13/-64 $
GP3 GEOM3,EQEXIN,GEOM2/,ETT/0/V,N,NOGRAV/0 $
```

FIGURE 1 - (Cont'd)

```
PARAML UPVC//C,N,TRAILER/2/V,N,ROWS $
MATGEN ,/UNIT/1/ROWS $
MODTRL UPVC////3 $
MPYAD UNIT,UPVC,/ASQR/ $
DIAGONAL ASQR/ATRM// $
ADD UPVC,/BSQR/(0.0,-1.0) $
DIAGONAL BSQR/BTRM// $
SDR2 CASECC,CSTM,MPT,DIT,EQEXIN,SIL,ETT,EDT,BGPDT,,,ATRM,EST,
  XYCDB/,,,OESCR,,/STATICS/S,N,NOSORT2 $
SDR2 CASECC,CSTM,MPT,DIT,EQEXIN,SIL,ETT,EDT,BGPDT,,,BTRM,EST,
  XYCDB/,,,OESCI,,/STATICS/S,N,NOSORT2 $
OFP  ,,,OESCR,,//S,N,CARDNO $
OFP  ,,,OESCI,,//S,N,CARDNO $
PARAM //STSR/7/-64 $
ENDALTER $
$
```

FIGURE 2 - CQUAD2, CTRIAG FINITE ELEMENT MODEL OF 10.00 CM DIA., 1 CM THK PLATE

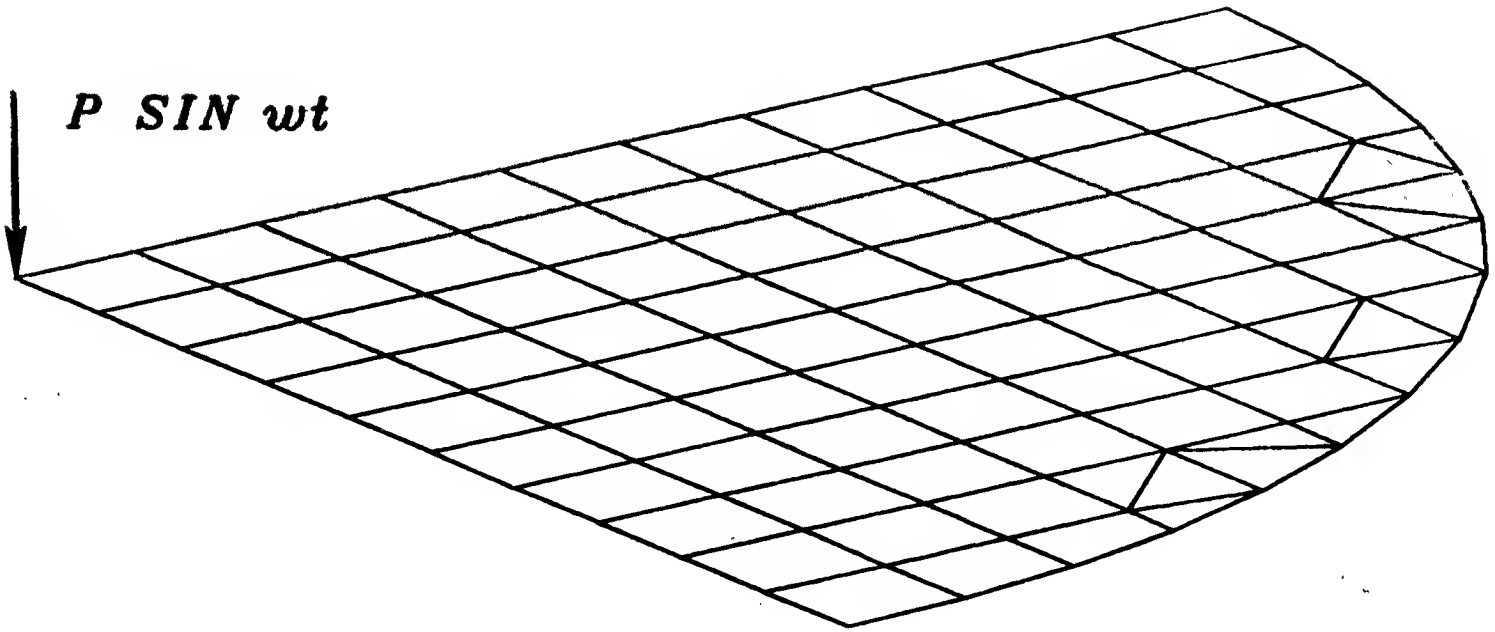
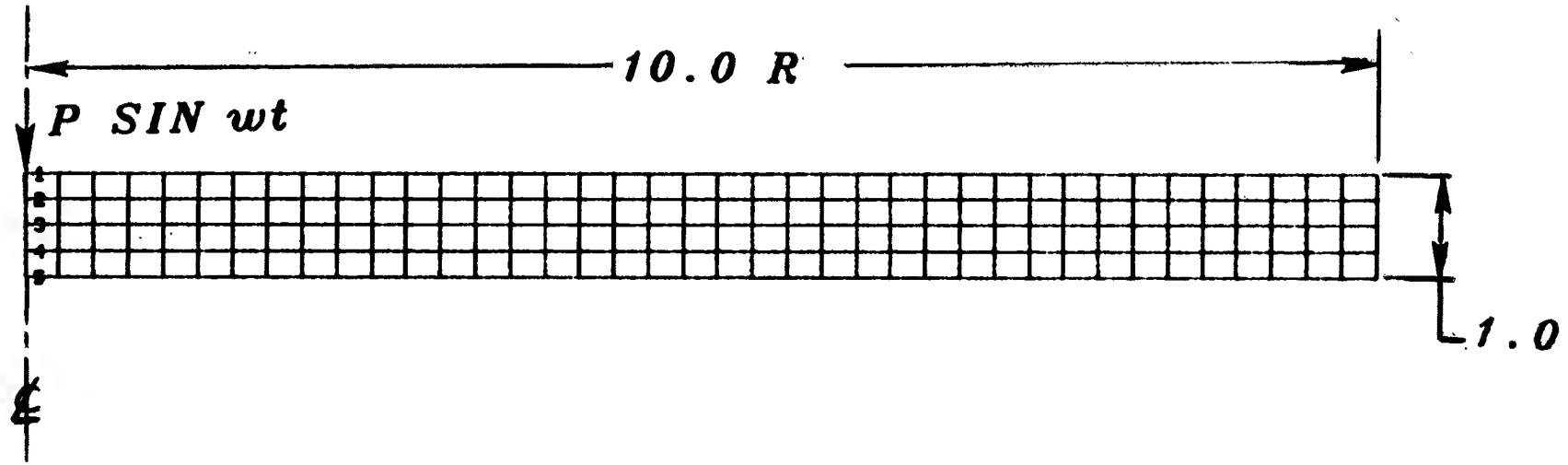


FIGURE 3 - CTRAPRG SOLID OF REVOLUTION FINITE ELEMENT MODEL



APPENDIX A

THE NASTPOST PROGRAM

```
C          DATA SET NASTPOST    AT LEVEL 017 AS OF 11/05/79                  00001
      COMMON /HDRCOM/TITLE(16),SUBT(16),LABEL(16)                            00002
      DATA DTIT/'$TIT'/,CASE/'CASE'/,DSUB/'$SUB'/,                           00003
     X     DELE/'$ELE'/,BSTR/' STR'/,DLAB/'$LAB'/                            00004
      DATA I036,I037/2*0/                                                    00005
    1 CONTINUE                                                               00006
      REWIND 7                                                               00007
C - GET TITLE CARD                                                           00008
    5 CONTINUE                                                               00009
      READ(7,900,END=999) TEMP,TITLE                                         00010
      IF(TEMP.EQ.DTIT) GO TO 6                                               00011
      GO TO 5                                                                00012
C - GET SUBTITLE CARD                                                        00013
    6 CONTINUE                                                               00014
      READ(7,900,END=999) TEMP,SUBT                                          00015
      IF(TEMP.EQ.DSUB) GO TO 7                                               00016
      GO TO 6                                                                00017
C - GET LABEL CARD                                                           00018
    7 CONTINUE                                                               00019
      READ(7,900,END=999) TEMP,LABEL                                         00020
      IF(TEMP.EQ.DLAB) GO TO 10                                              00021
      GO TO 7                                                                00022
C - GET STRESS CARD                                                          00023
   10 CONTINUE                                                               00024
      READ(7,910,END=999) TEMP                                               00025
      IF(TEMP.EQ.BSTR) GO TO 20                                              00026
      GO TO 10                                                               00027
C - GET SUBCASE IDENTIFICATION                                               00028
   20 CONTINUE                                                               00029
      READ(7,920,END=999) TEMP,ISID                                          00030
      IF(TEMP.EQ.CASE) GO TO 30                                              00031
      GO TO 20                                                               00032
C - GET ELEMENT TYPE                                                         00033
   30 CONTINUE                                                               00034
      READ(7,930,END=999) TEMP,IELTYP                                        00035
      IF(TEMP.NE.DELE) GO TO 5                                               00036
C - CHECK ELEMENT TYPES                                                      00037
      IF(IELTYP.EQ.36) GO TO 360                                             00038
      IF(IELTYP.EQ.37) GO TO 370                                             00039
      GO TO 5                                                                00040
C - ELEMENT TYPE = 36                                                        00041
  360 CONTINUE                                                               00042
      IF(I036 .EQ. 0) CALL RW36(ISID,IELTYP,IEOF)                            00043
      IF(I036 .EQ. 1) CALL RC36(ISID,IELTYP,IEOF)                            00044
      IF(I036 .EQ. 1 .AND. IEOF .EQ. 1) GO TO 999                            00045
      I036 = MOD(I036+1,2)                                                   00046
      GO TO 6                                                                00047
C - ELEMENT TYPE = 37                                                        00048
  370 CONTINUE                                                               00049
      IF(I037 .EQ. 0) CALL RW37(ISID,IELTYP,IEOF)                            00050
      IF(I037 .EQ. 1) CALL RC37(ISID,IELTYP,IEOF)                            00051
      IF(I037 .EQ. 1 .AND. IEOF .EQ. 1) GO TO 999                            00052
      I037 = MOD(I037+1,2)                                                   00053
      GO TO 6                                                                00054
  999 STOP                                                                   00055
  900 FORMAT(A4,6X,15A4,A2)                                                  00056
  910 FORMAT(8X,A4)                                                          00057
  920 FORMAT(4X,A4,8X,I9)
  930
```

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FORMAT(A4,12X,I11)                                                    58
      END                                                             00059
C          DATA SET NASTRU36   AT LEVEL 004 AS OF 11/02/79
      SUBROUTINE RU36(ISID,IELTYP,IEOF)                               00001
      DIMENSION TEMP(2),DATA(4)                                       00002
      DATA TITLE/'ST  '/,CONT/'-CON'/,BLANK/'    '/                   00003
      DATA INN,IOUT/7,9/                                              00004
      REWIND IOUT                                                     00005
        PRINT 10
10      FORMAT('SUBROUTINE RU36')
      READ(INN,900,END=999) IELNO,DATA(1),DATA(2),DATA(3)             00007
001     CONTINUE
      READ(INN,910,END=990) CARDN,DATA(4)                             00008
      IF(CARDN .NE. CONT) GO TO 990                                   00009
      WRITE(IOUT) ISID,IELTYP,IELNO,DATA                              00010
C     READ(INN,920,END=999) TEMP                                      00011
C     BACKSPACE INN                                                   00012
        CALL BACKSP(TEMP,INN,&999)
        IF(TEMP(1).EQ.BLANK)
     $  READ(10,900,END=999)IELNO,DATA(1),DATA(2),DATA(3)
      IF(TEMP(1) .EQ. BLANK) GO TO 001                                00013
      IF(TEMP(1) .NE. TITLE) GO TO 990                                00014
  800 CONTINUE                                                        00015
      ENDFILE IOUT                                                    00016
      REWIND IOUT                                                     00017
      RETURN                                                          00018
  990 CONTINUE                                                        00019
      STOP 3600                                                       00020
  999 IEOF = 1                                                        00021
      GO TO 800                                                       00022
  900 FORMAT(I10,8X,3E18.6)                                           00023
  910 FORMAT(A4,14X,3E18.6)                                           00024
  920 FORMAT(2A2)                                                     00025
      END                                                             00026
C          DATA SET NASTRU37   AT LEVEL 004 AS OF 11/02/79
      SUBROUTINE RU37(ISID,IELTYP,IEOF)                               00001
10      FORMAT('SUBROUTINE RU37')
      DIMENSION TEMP(2),DATA(20),KKREAD(33)
      DATA TITLE/'ST  '/,CONT/'-CON'/,BLANK/'    '/                   00003
      DATA INN,IOUT/7,8/                                              00004
      REWIND IOUT                                                     00005
      PRINT 10
      READ(INN,900,END=999) IELNO,DATA(1),DATA(2),DATA(3)             00007
001   CONTINUE
      READ(INN,910,END=990) CARDN,DATA(4),DATA(5),DATA(6)             00008
      IF(CARDN .NE. CONT) GO TO 990                                   00009
      READ(INN,910,END=990) CARDN,DATA(7),DATA(8),DATA(9)             00010
      IF(CARDN .NE. CONT) GO TO 990                                   00011
      READ(INN,910,END=990) CARDN,DATA(10),DATA(11),DATA(12)          00012
      IF(CARDN .NE. CONT) GO TO 990                                   00013
      READ(INN,910,END=990) CARDN,DATA(13),DATA(14),DATA(15)          00014
      IF(CARDN .NE. CONT) GO TO 990                                   00015
      READ(INN,910,END=990) CARDN,DATA(16),DATA(17),DATA(18)          00016
      IF(CARDN .NE. CONT) GO TO 990                                   00017
      READ(INN,910,END=990) CARDN,DATA(19),DATA(20)                   00018
      IF(CARDN .NE. CONT) GO TO 990                                   00019
      WRITE(IOUT) ISID,IELTYP,IELNO,DATA                              00020
C     READ(INN,920,END=999) TEMP                                      00021
C     BACKSPACE INN                                                   00022
      READ(INN,930,END=999)KKREAD
       REWIND 10
      WRITE(10,930)KKREAD
      REWIND
```

```
10
      READ(10,920)TEMP
      REWIND 10
      IF(TEMP(1) .EQ. BLANK)
     $ READ(10,900,END=999)IELNO,DATA(1),DATA(2),DATA(3)
      IF(TEMP(1).EQ.BLANK) GOTO 001                                    00024
      IF(TEMP(1) .NE. TITLE) GO TO 990                                 00025
  800 CONTINUE                                                         00026
      ENDFILE IOUT                                                     00027
      REWIND IOUT                                                      00028
      RETURN                                                           00029
  990 CONTINUE                                                         00030
      STOP 3700                                                        00031
  999 IEOF = 1                                                         00032
      GO TO 800                                                        00033
  900 FORMAT(I10,8X,3E18.6)                                            00034
  910 FORMAT(A4,14X,3E18.6)                                            00035
  920 FORMAT(2A2)
  930 FORMAT(33A4)                                                     00036
      END
C          DATA SET NASTRC36   AT LEVEL 025 AS OF 11/05/79            00001
      SUBROUTINE RC36(ISID,IELTYP,IEOF)
   10    FORMAT('SUBROUTINE RC36')                                     00002
      DIMENSION TEMP(2),DATAI(4),DATAR(4),RMAG(4),PHASE(4)             00003
      DATA TITLE/'ST  '/,CONT/'-CON'/,BLANK/'    '/                    00004
      DATA IPRT,INN,IOUT/6,7,9/
       PRINT 10                                                        00005
      IELCNT = 99                                                      00006
      RADDEG = 57.29578                                                00008
      READ(INN,900,END=999) IELNO,DATAI(1),DATAI(2),DATAI(3)
  001   CONTINUE                                                       00009
      READ(INN,910,END=990) CARDN,DATAI(4)                             00010
      IF(CARDN .NE. CONT) GO TO 990                                    00011
      READ(IOUT) ISIDR,IELTPR,IELNOR,DATAR                             00012
      IF(ISIDR .NE. ISID) GO TO 990                                    00013
      IF(IELTPR .NE. IELTYP) GO TO 990                                 00014
      IF(IELNOR .NE. IELNO) GO TO 990                                  00015
      DO 699 I = 1,4                                                   00016
        RMAG(I) = SQRT(DATAR(I)*DATAR(I) + DATAI(I)*DATAI(I))          00017
        IF(DATAR(I) .NE. 0.0) GO TO 690                                00018
        IF(DATAI(I) .EQ. 0.0) PHASE(I) = 0.0                           00019
        IF(DATAI(I) .GT. 0.0) PHASE(I) = 90.0                          00020
        IF(DATAI(I) .LT. 0.0) PHASE(I) = 270.0                         00021
        GO TO 699                                                      00022
  690   CONTINUE                                                       00023
        RATIO = ABS(DATAI(I)/DATAR(I))                                 00024
        PHASE(I) = ATAN(RATIO)*RADDEG                                  00025
        IF(DATAI(I).GE.0.0 .AND. DATAR(I).LT.0.0)                      00026
     X    PHASE(I) = PHASE(I) + 90.0                                  00027
        IF(DATAI(I).LT.0.0 .AND. DATAR(I).LT.0.0)                      00028
     X    PHASE(I) = PHASE(I) + 180.0                                 00029
        IF(DATAI(I).LT.0.0 .AND. DATAR(I).GT.0.0)                      00030
     X    PHASE(I) = PHASE(I) + 270.0                                 00031
  699 CONTINUE                                                         00032
C     WRITE(IPRT,930) ISID,IELTYP,IELNO,DATAR,DATAI                    00033
      IF(IELCNT .LT. 50) GO TO 700                                     00034
      CALL HD36(ISID)                                                  00035
      IELCNT = 0                                                       00036
  700 CONTINUE
      IELCNT = IELCNT + 1
```

```
                                    00037                                   00038
      WRITE(IPRT,940) IELNO,((RMAG(I),PHASE(I)),I=1,4)                       00039
C      READ(INN,920,END=999) TEMP                                            00040
C     BACKSPACE INN
        CALL BACKSP(TEMP,INN,&999)
        IF(TEMP(1).EQ.BLANK)
     $  READ(INN,900,END=999)IELNO,DATAI(1),DATAI(2),DATAI(3)                00041
      IF(TEMP(1) .EQ. BLANK) GO TO 001                                       00042
      IF(TEMP(1) .NE. TITLE) GO TO 990                                       00043
      RETURN                                                                 00044
  990 CONTINUE                                                               00045
      STOP 3601                                                              00046
  999 IEOF = 1                                                               00047
      RETURN                                                                 00048
  900 FORMAT(I10,8X,3E18.6)                                                  00049
  910 FORMAT(A4,14X,3E18.6)                                                  00050
  920 FORMAT(2A2)                                                            00051
  930 FORMAT(1X,3I10,2(/,4(5X,1PE12.5)))                                     00052
  940 FORMAT(1X,I5,8X,4(1PE12.5,' /',0PF10.5,5X))                            00053
      END
C          DATA SET NASTRC37   AT LEVEL 022 AS OF 11/05/79                  00001
      SUBROUTINE RC37(ISID,IELTYP,IEOF)
 10     FORMAT('SUBROUTINE RC37')                                           00002
      DIMENSION TEMP(2),DATAI(20),DATAR(20),RMAG(20),PHASE(20)               00003
      DATA TITLE/'ST  '/,CONT/'-CON'/,BLANK/'    '/                          00004
      DATA IPRT,INN,IOUT/6,7,8/
       PRINT 10                                                              00005
      IELCNT = 10                                                            00006
      RADDEG = 57.29578                                                      00008
      READ(INN,900,END=999) IELNO,DATAI(1),DATAI(2),DATAI(3)
  001   CONTINUE                                                             00009
      READ(INN,910,END=990) CARDN,DATAI(4),DATAI(5),DATAI(6)                 00010
      IF(CARDN .NE. CONT) GO TO 990                                          00011
      READ(INN,910,END=990) CARDN,DATAI(7),DATAI(8),DATAI(9)                 00012
      IF(CARDN .NE. CONT) GO TO 990                                          00013
      READ(INN,910,END=990) CARDN,DATAI(10),DATAI(11),DATAI(12)              00014
      IF(CARDN .NE. CONT) GO TO 990                                          00015
      READ(INN,910,END=990) CARDN,DATAI(13),DATAI(14),DATAI(15)              00016
      IF(CARDN .NE. CONT) GO TO 990                                          00017
      READ(INN,910,END=990) CARDN,DATAI(16),DATAI(17),DATAI(18)              00018
      IF(CARDN .NE. CONT) GO TO 990                                          00019
      READ(INN,910,END=990) CARDN,DATAI(19),DATAI(20)                        00020
      IF(CARDN .NE. CONT) GO TO 990                                          00021
      READ(IOUT) ISIDR,IELTPR,IELNOR,DATAR                                   00022
      IF(ISID .NE. ISIDR) GO TO 990                                          00023
      IF(IELTYP .NE. IELTPR) GO TO 990                                       00024
      IF(IELNOR .NE. IELNO) GO TO 990                                        00025
      DO 699 I = 1,20                                                        00026
        RMAG(I) = SQRT(DATAR(I)*DATAR(I) + DATAI(I)*DATAI(I))                00027
        IF(DATAR(I) .NE. 0.0) GO TO 690                                      00028
        IF(DATAI(I) .EQ. 0.0) PHASE(I) = 0.0                                 00029
        IF(DATAI(I) .GT. 0.0) PHASE(I) = 90.0                                00030
        IF(DATAI(I) .LT. 0.0) PHASE(I) = 270.0                               00031
        GO TO 699                                                            00032
  690   CONTINUE                                                             00033
        RATIO = ABS(DATAI(I)/DATAR(I))                                       00034
        PHASE(I) = ATAN(RATIO)*RADDEG                                        00035
        IF(DATAI(I).GE.0.0 .AND. DATAR(I).LT.0.0)                            00036
     X    PHASE(I) = PHASE(I) + 90.0                                        00037
        IF(DATAI(I).LT.0.0 .AND. DATAR(I).LT.0.0)
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     X    PHASE(I) = PHASE(I) + 180.0                                  00038
          IF(DATAI(I).LT.0.0 .AND. DATAR(I).GT.0.0)                    00039
     X    PHASE(I) = PHASE(I) + 270.0                                  00040
  699 CONTINUE                                                         00041
C     WRITE(IPRT,930) ISID,IELTYP,IELNO,DATAR,DATAI                    00042
      IF(IELCNT .LE. 7) GO TO 700                                      00043
      CALL HD37(ISID)                                                  00044
      IELCNT = 0                                                       00045
  700 CONTINUE                                                         00046
      IELCNT = IELCNT + 1                                              00047
      DO 710 I = 1,5                                                   00048
        J = 4*(I-1) + 1                                                00049
        K = J + 3                                                      00050
        IF(I .EQ. 1) WRITE(IPRT,940) IELNO,I,                          00051
     X      ((RMAG(IX1),PHASE(IX1)),IX1=J,K)                          00052
        IF(I .NE. 1) WRITE(IPRT,950) I,                                00053
     X      ((RMAG(IX1),PHASE(IX1)),IX1=J,K)                          00054
  710 CONTINUE                                                         00055
      WRITE(IPRT,960)                                                  00056
C     READ(INN,920,END=999) TEMP                                       00057
C     BACKSPACE INN                                                    00058
        CALL BACKSP(TEMP,INN,&999)
        IF(TEMP(1).EQ.BLANK)
     $  READ(10,900,END=999)IELNO,DATAI(1),DATAI(2),DATAI(3)
      IF(TEMP(1) .EQ. BLANK) GO TO 001                                 00059
      IF(TEMP(1) .NE. TITLE) GO TO 990                                 00060
      RETURN                                                           00061
  990 CONTINUE                                                         00062
      STOP 3701                                                        00063
  999 IEOF = 1                                                         00064
      RETURN                                                           00065
  900 FORMAT(I10,8X,3E18.6)                                            00066
  910 FORMAT(A4,14X,3E18.6)                                            00067
  920 FORMAT(2A2)                                                      00068
  930 FORMAT(1X,3I10,10(/,4(5X,1PE13.6)))                              00069
  940 FORMAT(1X,I5,1X,I3,4X,4(1PE12.5,' /',0PF10.5,5X))                00070
  950 FORMAT(7X,I3,4X,4(1PE12.5,' /',0PF10.5,5X))                      00071
  960 FORMAT(' ')                                                      00072
      END                                                              00073
C          DATA SET MASTHD36   AT LEVEL 007 AS OF 10/24/79
      SUBROUTINE HD36(ISID)                                            00001
10      FORMAT('SUBROUTINE HD36')
      COMMON /HDRCOM/TITLE(16),SUBT(16),LABEL(16)                      00002
       PRINT 10
      IPRT = 6                                                         00003
      WRITE(IPRT,100) TITLE                                            00004
      WRITE(IPRT,110) SUBT                                             00005
      WRITE(IPRT,120) LABEL,ISID                                       00006
      WRITE(IPRT,140)                                                  00007
      WRITE(IPRT,150)                                                  00008
      WRITE(IPRT,160)                                                  00009
      WRITE(IPRT,170)                                                  00010
      RETURN                                                           00011
  100 FORMAT('1',3X,15A4,A2)                                           00012
  110 FORMAT(' ',3X,15A4,A2)                                           00013
  120 FORMAT('0',3X,15A4,A2,50X,'SUBCASE',I3)                          00014
  130 FORMAT(' ')                                                      00015
  140 FORMAT(27X,'S T R E S S E S   F O R   T H E   T R I A N ',       00016
```

```
     X          'G U L A R   R I N G S   ( C T R I A R G )')          00017
  150 FORMAT(61X,'(MAGNITUDE/PHASE)')                                  00018
  160 FORMAT(4X,'EL',17X,'RADIAL',19X,'CIRCUMFERENTIAL',               00019
     X 19X,'AXIAL',24X,'SHEAR')                                        00020
  170 FORMAT(4X,'ID',19X,'(X)',24X,'(THETA)',24X,'(Z)',                00021
     X 26X,'(ZX)')                                                     00022
      END                                                              00023
C          DATA SET NASTHD37   AT LEVEL 006 AS OF 10/24/79
      SUBROUTINE HD37(ISID)                                            00001
10      FORMAT('SUBROUTINE HD37')
      COMMON /HDRCOM/TITLE(16),SUBT(16),LABEL(16)                      00002
       PRINT 10
      IPRT = 6                                                         00003
      WRITE(IPRT,100) TITLE                                            00004
      WRITE(IPRT,110) SUBT                                             00005
      WRITE(IPRT,120) LABEL,ISID                                       00006
      WRITE(IPRT,140)                                                  00007
      WRITE(IPRT,150)                                                  00008
      WRITE(IPRT,160)                                                  00009
      WRITE(IPRT,170)                                                  00010
      RETURN                                                           00011
  100 FORMAT('1',3X,15A4,A2)                                           00012
  110 FORMAT(' ',3X,15A4,A2)                                           00013
  120 FORMAT('0',3X,15A4,A2,50X,'SUBCASE',I3)                          00014
  130 FORMAT(' ')                                                      00015
  140 FORMAT(27X,'S T R E S S E S   F O R   T H E   T R A P E ',       00016
     X          'Z O I D A L   R I N G S   ( C T R A P R G )')        00017
  150 FORMAT(61X,'(MAGNITUDE/PHASE)')                                  00018
  160 FORMAT(4X,'EL',2X,'ST',13X,'RADIAL',19X,'CIRCUMFERENTIAL',       00019
     X 19X,'AXIAL',24X,'SHEAR')                                        00020
  170 FORMAT(4X,'ID',2X,'PT',15X,'(X)',24X,'(THETA)',24X,'(Z)',        00021
     X 26X,'(ZX)')                                                     00022
      END                                                              00023
        SUBROUTINE BACKSP(TEMP,INN,*)
        DIMENSION KKREAD(33),TEMP(2)
        READ(INN,930,END=999)KKREAD
        REWIND 10
        WRITE(10,930)KKREAD
        REWIND 10
        READ(10,920)TEMP
        REWIND 10
  930   FORMAT(33A4)
  920   FORMAT(2A2)
        RETURN
  999   RETURN 1
        END
$
```